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SHORT COMMUNICATION article

Postoperative analgesic efficacy of caudal bupivacaine alone versus caudal bupivacaine plus fentanyl in Libyan children undergoing infraumbilical surgery: A prospective controlled comparative

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Abstract: Caudal epidural analgesia is one of the most commonly used regional anesthesia techniques in children undergoing infraumbilical surgery. Bupivacaine provides effective postoperative pain control; however, its duration may be limited. Fentanyl has been used as an adjuvant to prolong analgesia. To compare the efficacy and safety of caudal bupivacaine alone versus caudal bupivacaine combined with fentanyl in pediatric patients undergoing elective infraumbilical surgery. This prospective controlled comparative study was conducted between May 2025 and May 2026 at Misurata Medical Center and the National Cancer Institute, Misurata, Libya. 67 children aged 1 - 6 years with ASA physical status I - II were included. 38 patients received caudal bupivacaine 0.2% (Group A), while 38 received caudal bupivacaine plus fentanyl (Group B). The primary outcome was time to first rescue analgesia. Intravenous paracetamol 20.0 mg/kg was administered when postoperative analgesia was required. Demographic characteristics and duration of surgery were comparable between groups. The mean time to first rescue analgesia was significantly longer in Group B (9.50 ± 0.88 hrs) than in Group A (5.42 ± 1.10 hrs). Postoperative vomiting occurred in three patients in Group A and five patients in Group B. No respiratory depression or pruritus was observed. The addition of fentanyl to caudal bupivacaine significantly prolonged postoperative analgesia without increasing major adverse effects.

Introduction

Postoperative pain management is a fundamental component of pediatric perioperative care. Adequate analgesia improves patient comfort, facilitates recovery, and reduces physiological stress responses. Regional anesthesia techniques are increasingly used in pediatric surgical practice as part of multimodal analgesic strategies and have been shown to provide safe and effective perioperative care in children [1-4]. Caudal epidural block remains the most commonly performed regional anesthesia technique in children undergoing infraumbilical procedures. The technique is simple, reliable, and associated with a high success rate. It reduces perioperative opioid requirements and contributes to improved postoperative recovery [1, 4, 5]. Bupivacaine is widely used for caudal analgesia

because of its favorable duration of action and safety profile. Nevertheless, a single-shot caudal injection may not provide sufficient postoperative analgesia for the entire recovery period. To overcome this limitation, several adjuvant agents have been investigated [6-9].

Fentanyl is a potent synthetic opioid that acts primarily on spinal opioid receptors. When added to local anesthetics, fentanyl may prolong the duration of postoperative analgesia and improve overall pain control. Despite widespread clinical use, the magnitude of benefit and safety profile remain subjects of continued investigation [6, 10-12]. Limited data are available from Libya regarding pediatric caudal analgesia. Therefore, this study was conducted to evaluate the efficacy and safety of adding fentanyl to caudal bupivacaine in children undergoing elective infraumbilical surgery.

Materials and methods

Study design and setting: This prospective controlled comparative study was conducted between May 2025 and May 2026 at Misurata Medical Center and the National Cancer Institute, Misurata, Libya.

Participants: A total of 76 pediatric patients aged 1 - 6 years with ASA physical status I - II were enrolled.

Inclusion criteria: Age 1 - 6 years, weight 9 - 22 Kg, elective infraumbilical surgery, ASA I - II.

Exclusion criteria: Local infection at the caudal site, allergy to local anesthetics or fentanyl, sacral anomalies, vertebral abnormalities, bleeding disorders, and neurological disorders.

Anesthetic technique: Standard monitoring included ECG, non-invasive blood pressure, pulse oximetry, and capnography. General anesthesia was induced with intravenous propofol, 1.0 mcg fentanyl per Kg, following intravenous cannulation. In uncooperative children or those with difficult intravenous access, inhalational induction with sevoflurane was performed before establishing intravenous access [1, 5, 13].

Patients were positioned laterally, and a caudal epidural block was performed under strict aseptic precautions using a 24-gauge intravenous cannula. Correct placement was confirmed by negative aspiration for blood and cerebrospinal fluid.

Group A received caudal bupivacaine 0.2% at 1.0 mL/Kg (maximum 20.0 mL), and Group B received caudal bupivacaine 0.2% containing fentanyl (2.0 µg/mL), administered at a total volume of 1.0 mL/Kg (maximum volume 20.0 mL).

Airway management was achieved using either an endotracheal tube or an i-gel device. Intravenous fluids were administered according to patient requirements.

Outcome measures: Primary outcome: Time to first rescue analgesia. Secondary outcomes: vomiting, respiratory depression, pruritus, and other adverse events.

Rescue analgesia: Intravenous paracetamol 20.0 mg/Kg was administered when postoperative analgesia was required.

Ethical considerations: The study was approved by the Research Ethics Committee of Misurata Medical Center. Written informed consent was obtained from parents or legal guardians (016-MJ-0020).

Statistical analysis: Continuous variables were expressed as mean ± standard deviation. Independent sample t-tests were used for quantitative variables. Chi-square or Fisher's exact tests were used for categorical variables. Statistical significance was set at $p < 0.05$.

Results

A total of 76 children completed the study and were equally allocated to two groups: Group A (bupivacaine group), comprising 38 patients who received caudal bupivacaine 0.2%. Group B (Bupivacaine-Fentanyl group): 38 patients received caudal bupivacaine 0.2% containing fentanyl (2.0 µg/mL), administered at a total volume of 1.0 mL/Kg.

Table 1: Baseline characteristics of the study population

Variable	Group A Bupivacaine	Group B Bupivacaine plus Fentanyl	P-value
Age in years	3.42 ± 1.75	3.29 ± 1.63	0.735
Weight in Kg	15.11 ± 3.62	14.84 ± 3.55	0.750
Duration of surgery in min	35.24 ± 7.81	37.29 ± 7.53	0.247

There were no statistically significant differences between the two groups regarding demographic characteristics.

Table 2: Gender distribution of the participants

Gender	Group A	Group B
Male	28 (73.7%)	31 (81.6%)
Female	10 (26.3%)	07 (18.4%)

Table 3: Duration of postoperative analgesia

Variable	Group A	Group B	P-value
Time to first rescue analgesia (hours)	5.42 ± 1.10 hours	9.50 ± 0.88 hours	< 0.001

The mean time to first rescue analgesia was significantly longer in Group B than in Group A. This represents an approximately four-hour increase in postoperative analgesia following the addition of fentanyl.

Table 4: Postoperative adverse events of the Libyan participants

Complication	Group A	Group B
vomiting	3 (7.9%)	5 (13.2%)
Respiratory depression	0	0
Pruritus	0	0
Urinary retention	0	0
Excessive sedation	0	0

Discussion

The principal finding of this study was the significant prolongation of postoperative analgesia following the addition of fentanyl to caudal bupivacaine. Similar findings have been reported previously [6, 7, 10, 11]. Children receiving fentanyl experienced approximately four additional hours of postoperative pain relief before requiring rescue analgesia. These findings support previous evidence suggesting a synergistic interaction between local anesthetics and neuraxial opioids [8, 9]. The prolonged analgesic effect observed in this study is clinically relevant because it may reduce the need for additional analgesics during the early postoperative period [6, 10, 12]. Importantly, no cases of respiratory depression, pruritus, urinary retention, or excessive sedation were observed. These findings support the favorable safety profile of low-dose caudal fentanyl when administered under appropriate perioperative monitoring [2, 5, 14, 15]. Adequate postoperative pain management remains an essential

component of pediatric perioperative care and recovery [16]. This study contributes regional data from Libya and demonstrates the feasibility of implementing effective pediatric regional anesthesia protocols in local healthcare institutions. Strengths of the study include its prospective design, inclusion of two institutions, and clinically relevant outcome measures [17]. However, limitations include the non-randomized design, moderate sample size, and absence of recorded FLACC scores for statistical analysis. Future multicenter studies with larger sample sizes and standardized pain scoring systems are recommended.

Conclusion: The addition of fentanyl (2.0 µg/ml) to caudal bupivacaine significantly prolonged postoperative analgesia in children undergoing elective infraumbilical surgery without increasing major adverse effects. The combination demonstrated an acceptable safety profile and may represent an effective and practical strategy for postoperative pain management in pediatric patients.

References

1. Mossetti V, Vicchio N, Ivani G. Local anesthetics and adjuvants in pediatric regional anesthesia. Current Drug Targets. 2012; 13(7): 952-960. doi: 10.2174/138945012800675713
2. Elfawal SM, Abdelaal WA, Hosny MR. A comparative study of dexmedetomidine and fentanyl as adjuvants to levobupivacaine for caudal analgesia in children undergoing lower limb orthopedic surgery. Saudi Journal of Anesthesia. 2016; 10(4): 423-427. doi: 10.4103/1658-354X.179110
3. Jarraya A, Elleuch S, Zouari J, Smaoui M, Laabidi S, Kolsi K. Postoperative analgesia in children when using clonidine in addition to fentanyl with bupivacaine given caudally. Pan African Medical Journal. 2016; 24: 182. doi: 10.11604/pamj.2016.24.182
4. El-Feky EM, Abd El Aziz AA, Elawady MM. Enhancement of bupivacaine caudal analgesia using nalbuphine compared with fentanyl in children undergoing infraumbilical surgery. Ain-Shams Journal of Anesthesiology. 2019; 11: 1-7. doi: Nil.
5. Zhu C, Wei R, Tong Y, Liu J, Song Z, Zhang S. Analgesic efficacy and impact of caudal block on surgical complications of hypospadias repair: A systematic review and meta-analysis. Regional Anesthesia and Pain Medicine. 2019; 44(2): 259-267. doi: 10.1136/rapm-2018-000022
6. Walker BJ, Long JB, De Oliveira GS Jr, Szmuk P, Setiawan C, Polaner DM, et al. Complications in pediatric regional anesthesia. Anesthesiology. 2018; 129(4): 721-732. doi: 10.1097/ALN.0000000000002372
7. Bosenberg A. Benefits of regional anesthesia in children. Pediatric Anesthesia. 2019; 29(5): 512-520. doi: 10.1111/j.1460-9592.2011.03691.x
8. Xu W, Li Y, Zhang H. Methods of prolonging the effect of caudal block in children: An updated review. Frontiers in Pediatrics. 2024; 12: 1406263. doi: 10.3389/fped.2024.1406263
9. Shah UJ, Karuppiah N, Karapetyan H, Martin J, Sehmbi H. Analgesic efficacy of adjuvant medications in the pediatric caudal block for infraumbilical surgery: A network meta-analysis of randomized controlled trials. Cureus. 2022; 14(8): e28582. doi: 10.7759/cureus.28582
10. Suresh S, Schaldenbrand K, Wallis B, De Oliveira GS Jr. Regional anaesthesia to improve pain outcomes in paediatric surgical patients: a qualitative systematic review of randomized controlled trials. British Journal of Anaesthesia. 2014; 113(3): 375-90. doi: 10.1093/bja/aeu156
11. Polaner DM, Taenzer AH, Walker BJ, Bosenberg A, Krane EJ, Suresh S, et al. Pediatric Regional Anesthesia Network (PRAN): A multi-institutional study of the use and incidence of complications of pediatric regional anesthesia. Anesthesia and Analgesia. 2012; 115(6): 1353-1364. doi: 10.1213/ANE.0b013e31825d9f4b
12. Davidson AJ, Morton NS, Arnup SJ, de Graaff JC, Disma N, Withington DE, et al. General anesthesia compared to Spinal anesthesia (GAS) Consortium. Apnea after awake regional and general anesthesia in infants: The general anesthesia compared to spinal anesthesia study-comparing apnea and neurodevelopmental outcomes, a randomized controlled trial. Anesthesiology. 2015; 123(1): 38-54. doi: 10.1097/ALN.0000000000000709
13. Pardessus P, Maroun Y, Ferahtia L, Sammoud Z, Kaddour R, El Bachraoui C, et al. Postoperative pain management in children. Frontiers in Pediatrics. 2026; 14: 1777446. doi: 10.3389/fped.2026.1777446
14. Alshami HA, Hussein MSE, Elmhadwi SJ, Alfitory MZ, Alfsay SK, Abdalmuneim R, et al. Comparison between isoflurane and sevoflurane in inhalation anesthesia: A prospective study. Mediterranean Journal of Pharmacy and Pharmaceutical Sciences. 2023; 3(3): 20-26. doi: 10.5281/zenodo.8262368

15. Kumar P, Rudra A, Pan AK, Acharya A. Caudal additives in pediatrics: A comparison among midazolam, ketamine, and neostigmine coadministered with bupivacaine. Anesthesia and Analgesia. 2005; 101(1): 69-73. doi: 10.1213/01.ANE.0000153862.95153.2E
16. Dua A, Kaye AD, Urman RD. Caudal anesthesia. Treasure Island (FL): StatPearls Publishing; 2025. Bookshelf ID: NBK551693. PMID: 31869157
17. Syed Nizamuddin SF. Xylazine-fentanyl crisis in North America: Epidemiology, clinical impact, and harm reduction. Mediterranean Journal of Medicine and Medical Sciences. 2025; 1(2): 32-36. doi.10.5281/zenodo.17058720

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